Compensatory measures for wildlife conservation: testing the effect of deadwood and cavity supply on cavity users in managed boreal forest

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Context

Forest management leads to a decrease in the proportion of **old forest**[1,2,3] and in the quality/amount of **deadwood**[4,5,6]. The simplification of the internal forest structure and the overabundance of second growth forest stands may be a limiting factor for associated wildlife[7,8,9].

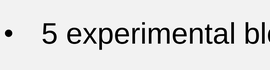


Figure 1. Managed forest in study area

Ecosystem-based forest management is the established approach under Quebec's new forest regime to address environmental challenges.

Anthropogenic supply of standing deadwood[10,11] and cavities[12,13,14] may have a positive impact on associated biodiversity.

Objective

Determine whether an **anthropogenic compensatory measure** (deadwood and cavity supply) in a managed boreal forest can emulate attributes of an old-growth forest and allow the presence and reproduction of deadwood associated species.

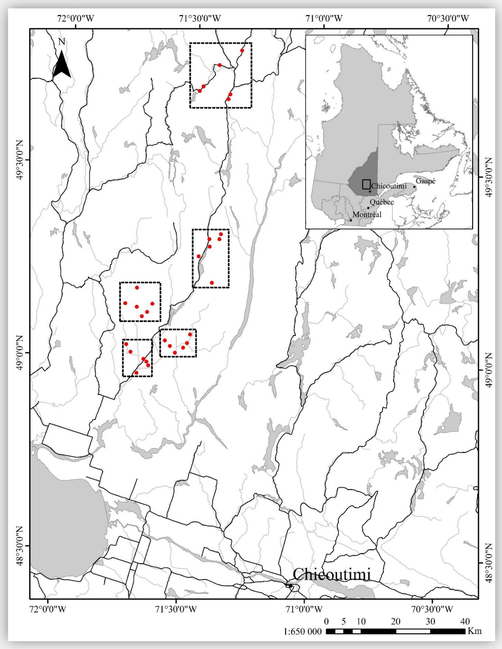
e.g.: Curculionidae (Scolytinae), Cerambycidae, Formicidae

e.g.: Black-backed Woodpecker, American Three-toed Woodpecker

e.g.: Boreal owl, Boreal chickadee, Red squirrel

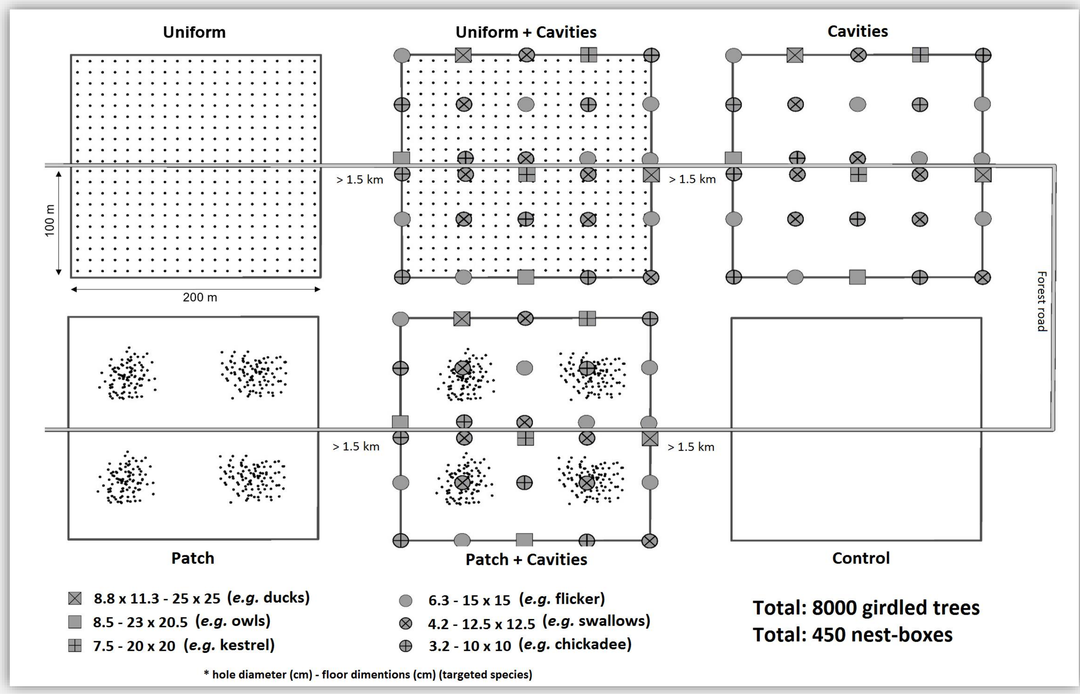
Study area

- Eastern Canadian boreal forest under management
- Before-After– Control-Impact (BACI)[15] (2015-2016)
- 5 experimental blocks of 6 sampling units (SU)
- 1 treatment per SU per block
  - Deadwood distributed uniformly
  - Deadwood distributed in patch
  - Deadwood distributed uniformly with cavities
  - Deadwood distributed in patch with cavities
  - Cavities
  - Control
- Forest stands
  - Black spuce
  - 50 - 70 years old
  - ≥ 4 hectares
  - Similar tree composition
  - Distanced >1.5 km
  - Crossed by a forest road
  - Excluding perturbations and watercourse

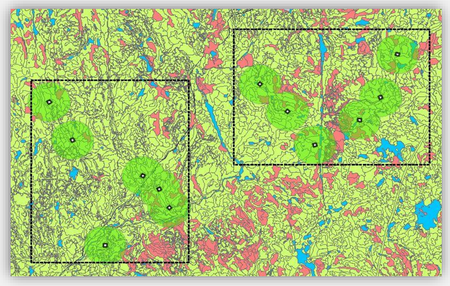


Methods

- Bird surveys (Springs 2015 and 2016)
  - Point counts (15 min.)
  - Playback: BOCH, RBNU, ATTW, BBWO, NOFL, BOOW, NHOW
  - Recordings: omnidirectional microphone/ *TASCAM* recorder
  - Unlimited radius
  - Post sampling identification
- Saproxylic insects surveys (Springs 2015 and 2016)
  - Trunk Windows Trap
  - Ethanol [70%]
- Nest-boxes survey during breeding season (Spring 2016)
  - Breeding success
  - Motion-detection cameras for occupied nest-boxes



- Vegetation plots
  - Trees (400m^2)
  - Natural deadwood (1250m^2)
- Woodpecker feeding marks
  - Number of holes
  - Scaling surface
  - Sampling of 40 trees / treatment with deadwood
- Landscape scale analysis
  - Buffer around sampling units (1, 2.5 and 5 km)



Partial results

Saproxylic beetles

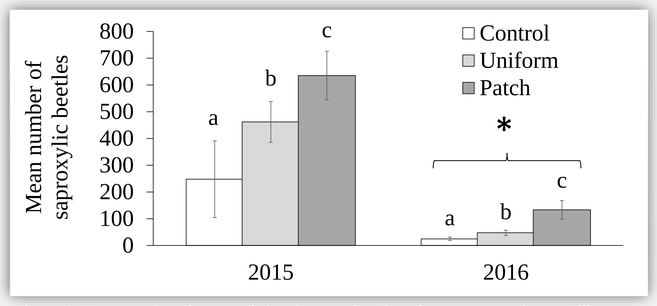


Figure 2. Mean number of saproxylic beetles as a function of treatments and year. Different letters refer to significant differences (α = 0.05). Asterix indicates that all means of 2016 are different than those of 2015. Method: Linear mixed-effects model.

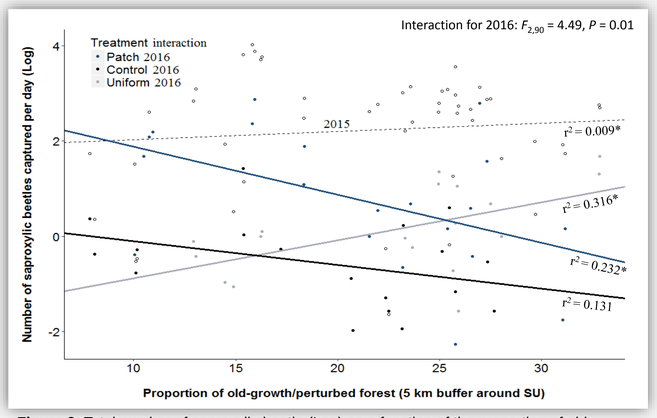


Figure 3. Total number of saproxylic beetle (Log) as a function of the proportion of old-growth/perturbed forest within a 5 km buffer around sampling units. Asterix indicates significant slopes (α = 0.05). Method: Linear mixed-effects model.

Feeding marks

Table 1. Type III tests of fixed effects on occurrence probability of woodpecker feeding marks (α = 0.05). Method: General linear model (Logit link).

Fixed effects	Estimate	SD	*P*
Treatment	4.693	1.633	**0.004**
Proportion of old-growth/perturbed forest	0.250	0.067	**<0.001**
Mean DBH of black spruce in vegetation plot	0.766	0.319	**0.016**
Total number of saproxylic beetles at the nearest trap	0.001	0.0004	**0.005**
Forest stand density	-0.001	0.001	0.324
DHP of the sampled tree	0.001	0.042	0.987
Natural deadwood on vegetation plot	-0.028	0.032	0.383
Natural deadwood on vegetation plot *Treatment	-0.213	0.071	**0.003**

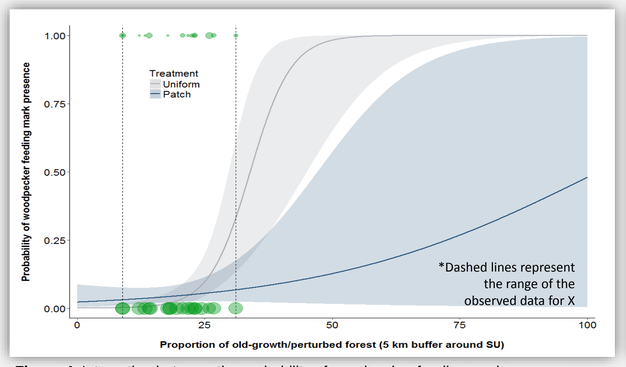


Figure 4. Interaction between the probability of woodpecker feeding mark presence (±95% CI) and the proportion of old-growth/perturbed forest within a 5 km buffer around sampling units. Method: General linear model (Logit link).

Figure 5. Exemple of a fresh woodpecker feeding mark on a girdled black spruce

Nest boxes

- 6 Boreal Chickadee Successes
- Two smaller nest boxes

Point counts

- Diversity index (2015 vs. 2016)
- Multivariate analyses

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